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ABSTRACT

This study examined the relationships between ATM (asynchronous transfer mode) adoption in universities and four organizational variables: university size, type, finances, and information processing maturity. Another purpose of the study was to identify the current status of ATM adoption in campus networking. Subjects were university domain LAN (local area network) administrators in the United States. A questionnaire was posted on the World Wide Web, and Internet e-mail was used to distribute the cover letter. A total of 199 usable responses were received. Logistic regression was used to study the relationship between the variables and ATM adoption, and nested models and an enrollment size model were designed for analyzing data. Results indicated that ATM adoption in campus networking is significantly related to the selected organizational variables. Tables present data on: frequencies for ATM adoption status; descriptive statistics for the predictor variables and categorical variables; and logistic regression coefficients and goodness-of-fit for the nested models and for the enrollment size model. (DLS)

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ATM Technology Adoption in U.S. Campus Networking

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Abstract: ATM is an emerging technology in computer networking. The technology provides potentiality for universities to build their networks based on the future vision of uniting voice, data, and video communications on ATM-technology-based equipment. A review of the literature revealed that minimal evidence exists to indicate whether the size, type, financial factors, and information processing maturity of a university affect a university's high-tech innovation adoptions. The purpose of this study was to determine the relationships between ATM adoption and four organizational variables: university size, type, finances, and information processing maturity. The results of the study provided evidence to show that ATM adoption in campus networking is significantly related to university size, type, finances, and information processing maturity.

Introduction

Today, information and telecommunication technologies have elevated human communication, information, and information resources exchange to the highest stages they have ever been. As requests for additional and the latest information in education increase, institutions of higher learning are striving to provide the latest information and information resources for university faculty members, researchers, and students. To meet the challenge of the need for information, higher education institutions are compelled to continue adopting state-of-the-art technologies to information and telecommunication systems to upgrade their information processing facilities.

ATM (asynchronous transfer mode) is an emerging technology in computer networking, which in turn is the physical media of information systems and networking/telecommunication (N/T) systems. The major benefit of ATM is of its potentiality for users to build networks based on the future vision of uniting voice, data, and video communications on ATM-technology-based equipment [McDysan & Spohn 1995]. Having realized the significant values of ATM on current campus networks and the potential of ATM to improve performance and lower overall network, equipment, and operating costs in the long term, some higher education institutions have adopted or are planning to adopt ATM in their campus networks. However, a review of the literature revealed that, in university settings, there is minimal evidence indicating whether the size, type, financial factors, and information processing maturity of a university would affect a university's high-tech innovation adoptions. No research of this nature has been found in any study of ATM adoption in any institutions of higher learning, nor has any research of this nature been undertaken by other organizations, either.

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Purpose of the Study

The purpose of this study was to determine the relationships between ATM adoption and the following factors: university size, university type, university finances, and university information processing maturity. Another purpose of the study was to identify the current status of ATM adoption in campus networking.

Methodology

The research design for this study was correlational since this method permits one to analyze the relationships among a number of variables in a single study [Borg & Gall 1989]. The sample subjects were selected from the population of university domain LAN administrators in the United States. The list of the user address of these university domain LAN administrators in the United States was accessed electronically by using the InterNic.

The total student enrollment of a university was defined as university size and was obtained from National Center for Educational Statistics 1996 database. University type was specially defined as Research Universities and non-research universities for this study. The list of Research Universities was obtained from the technical report published by The Carnegie Foundation for the Advancement of Teaching: *A Classification of Institutions of Higher Education: 1994 Edition* [The Carnegie 1994]. The percentage of a university's overall information technology expenditures that is expended for the university's campus N/T budget is defined as university finances. It was obtained from two sources. One source was the *Report on 1994 and 1995 Budget Information* [CAUSE 1996] by CAUSE Institution Database Service. The other source was a researcher developed instrument, which contained questionnaire items designed for obtaining the data.

The questionnaire was posted on the World Wide Web. Internet e-mail was used to distribute the cover letter of the questionnaire to each university domain LAN administrator. A total of 554 user addresses were actually sent through via the Internet. From the 554 user addresses sent through, a total of 208 responses were received for a response rate of 37.55%. Out of the 208 responses, 9 were unusable, leaving 199 usable, yielding a usable response rate of 35.92%.

Logistic regression was used to study the relationship between the selected organizational variables and ATM adoption in a university's campus networking. Nested Models were designed for analyzing the data in the study.

Findings

Categorical Statistics

ATM Adoption Status

Of the 199 responses received, 58 universities stated that they had adopted ATM technology, which was almost 30% of the responses. Of these 58 universities which have adopted ATM, 51.7% were Research Universities, 22.4% were Doctorate-Granting Universities, and 25.9% are neither Research Universities, nor Doctorate-Granting Universities. The frequencies for ATM adoption are shown in [Tab. 1] and [Tab. 2].

Status	Freq	Percent
Adopted	58	29.1
Non-Adopted	141	70.9
Total	199	100.0

Table 1: Frequencies for ATM Adoption Status I

University Type	Adopted		Non-Adopted		Total
	Freq	Percent	Freq	Percent	
Research	30	51.7	16	11.4	46
Doctorate	13	22.4	23	16.3	36
Neither	15	25.9	102	72.3	117
Total	58	100.0	141	100.0	199

Table 2: Frequencies for ATM Adoption Status II

Descriptive Statistics

Descriptive statistics (mean and standard deviation) for both the dependent and independent variables are reported in this section. Means for Overall IT Budget (m = 6.81) and Budget for Network/Telecom (m = 15.97) indicate that in universities an average of 15.97% of the overall Educational and General (E & G) budget that is expended for information technology is allocated to campus N/T. [Tab. 3] depicts the descriptive statistics for the predictor variables.

Variables CDATA, CUDMK, CDEPTDMK, CSTRUDMK, CUNSTRDM, and CLRNSCH are based on a scale of 1 to 6, with 1 = Strongly Disagree and 6 = Strongly Agree. High values represent high information processing maturity. Similarly, but in the opposite direction, CUDMK, CDEPTDMK, and CSTRUDMK are based on 1 (Strongly Disagree) to 6 (Strongly Agree), with low values representing high information processing maturity.

Variable	Variable Label	Mean	Std Dev
ADOPT	Adoption Status (Dummy, 1=Adopted)	29	46
ENROLLMT	Enrollment	11722.85	9661.26
UTYPE	University Type (Dummy, 1=Research)	23	42
ITBUDGET	Overall IT Budget	6.81	7.74
NTBUDGET	Budget for Network/Telecom	15.97	15.16
CDATA	Data/Information Handling	*4.32	1.49
CUDMK	Univ. Level Decision-Making	*3.11	1.29
CDEPTDMK	Dept/College level Decision-making	*3.27	1.30
CSTRUDMK	Structured Decision-Making	*3.15	1.35
CUNSTRDM	Unstructured Decision-Making	*3.55	1.28
CLRNSCH	Learning/Research	*5.05	1.18

SPEED	Speed, Bandwidth, Efficiency Improvement (Dummy, 1=Improved)	93	26
PLAN	ATM Plan (Dummy, 1=Planned)	55	50
COST	Dollars on ATM up to date	835425.53	2423261.55
YR1	Planned Money for 96	354046.51	407255.68
YR2	Planned Money for 97	381428.57	358069.49
YR3	Planned Money for 98	457972.97	897998.90
YR4	Planned Money for 99	549687.50	644806.72

Note: * Scale of 1 to 6 (Strongly Disagree to Strongly Agree)

Table 3: Descriptive Statistics for the Predictor Variables and Categorical Variables

Logistic Regression Results

Variable	Model 1		Model 2		Model 3		Model 4	
	(	Exp ((	(	Exp ((	(	Exp ((	(	Exp ((
ENROLLMT	.00008***	1.0001	.00003	1.0000	.00002	1.0000	.00002	1.0000
UTYPE			1.6733***	5.3297	1.6505***	5.2095	1.5204**	4.5740
NTBUDGET					.0528***	1.0542	.0526***	1.0540
MT1							.6980*	2.0098
MT2							.3479	1.4161
Model (χ^2	23.979		37.519		53.953		59.618	
DF	1		2		3		5	
Significance	.0000		.0000		.0000		.0000	

*p< .05; **p< .01; ***p< .001

Table 4: Logistic Regression Coefficients and Goodness-of-Fit for the Nested Models

Nested Models were used to analyze model variables. The logistic regression coefficients for the Nested Models are listed in [Tab. 4]. According to Norusis (1994), the logistic coefficient can be interpreted as the change in the log odds associated with a one-unit change in the independent variable. The logit (the log of odds) is represented by the coefficient under (. Since it is easier to think of odds rather than log odds [Norusis 1994], the logistic model uses *Exp (* (exponential function of coefficient) to represent odds, interpreted as by increasing the value of the independent variable's coefficient from 0 to 1 the odds are

increased by a factor of the value under *Exp (*. If the independent variable's coefficient value (is positive, this factor will be greater than 1, which means that the odds are increased; if (value is negative, the factor will be less than 1, meaning that the odds are decreased. Based on this rule of thumb and the coefficient values revealed in [Tab. 4], the interpretation of these models is stated in each of the individual sections to follow.

Model 1

Variable ENROLLMT (university enrollment) was entered in Model 1 as the independent variable. The regression coefficient for ENROLLMT is .00008 and the exponential function of the coefficient (*Exp (*) is 1.0001. The coefficient is positive and significant at the .001 level. Therefore, it can be concluded that there is a statistically significant relationship between dependent variable ATM Adoption and the independent variable ENROLLMT. The odds ratio = 1.0001 indicates that (without size classification) larger universities are 0.01% more likely than smaller universities to adopt ATM.

The model chi-square tests the null hypothesis that the coefficient in the current model, except the constant, is 0 (Norusis, 1994). This is comparable to the overall *F* test for regression. If Model (^{2} is statistically significant beyond p = .05, it indicates that the predictor variable contributes no chance to the explanation of the dependent variable [Menard 1995]. In this model, a Model (^{2} of 23.979 relative to one degree of freedom is obviously statistically significant beyond p = .05, which indicates that university size is significantly associated with ATM adoption.

Model 2

Model 2 included independent variables ENROLLMT and UTYPE. The (coefficients for ENROLLMT and UTYPE are .00003 and 1.6733 respectively. The *Exp (* value for ENROLLMT is 1.0000, for UTYPE is 5.3297. The p-value for ENROLLMT is p > .05, indicating that, controlling for variable UTYPE, there is a weak relationship between university size and ATM adoption.

The p-value for UTYPE is p < .001. Therefore, we can conclude that, irrespective of university size, there is a statistically significant relationship between ATM Adoption and UTYPE. To be more specific, the odds ratio 5.3297 shows that, net of university size, the odds of adopting ATM for Research Universities is 433% greater than for non-research universities.

Model 2 has a Model (^{2} of 37.519 relative to two degrees of freedom, which is statistically significant beyond p = .05. Compared to Model 1, Model 2 improves the goodness-of-fit (37.519 - 23.979 = 13.540) (2 - 1 = 1). As a result, Model 2 is better than Model 1 because variable university type further improves the fit by ((^{2} = 13.540 relative to one degree of freedom.

Model 3

Variable ENROLLMT, UTYPE, and NTBUDGET were involved in Model 3. The p-value for ENROLLMT is p > .05, indicating that, controlling for variables UTYPE and NTBUDGET, there is a weak relationship between university size and ATM adoption. The p-value for UTYPE and NTBUDGET is p < .001. A p-value less than .001 allows us to conclude that, regardless of ENROLLMT and NTBUDGET, there is a statistically significant relationship between ATM Adoption and UTYPE; that, regardless of ENROLLMT and UTYPE, there is a statistically significant relationship between ATM Adoption and NTBUDGET.

The odds ratio for UTYPE is 5.2095, which indicates that, net of university size and N/T budget, the odds of adopting ATM for Research Universities is 421% greater than for non-research universities. The odds ratio 1.0542 for NTBUDGET indicates that, net of university size and university type, the odds of adopting ATM for universities with higher networking/telecommunication budget are 5.42% greater than for universities with lower N/T budget. It is apparent that both university type and N/T budget are significant predictors of ATM adoption in campus networking, university type in particular.

Model 3 shows a Model (^{2} of 53.953 relative to three degrees of freedom, which is statistically significant beyond p = .05. Compared to Model 2, Model 3 improves the goodness-of-fit (53.953 - 37.519 = 16.434) (3 - 2 = 1). As a result, Model 3 is better than Model 2 because variable N/T budget further improves the fit by ((^{2} = 16.434 relative to one degree of freedom.

Model 4

Variable ENROLLMT, UTYPE, NTBUDGET, MT1, and MT2 were entered in Model 4. The p-value for ENROLLMT is p > .05, indicating that, controlling for variables UTYPE, NTBUDGET, MT1, and MT2, there is a weak relationship between university size and ATM adoption. The p-value for UTYPE and NTBUDGET is p < .001. A p-value less than .001 allows us to conclude that, regardless of ENROLLMT, NTBUDGET, MT1, and MT2, there is a statistically significant relationship between ATM Adoption and UTYPE; that, regardless of ENROLLMT, UTYPE, MT1, and MT2, there is a statistically significant relationship between ATM Adoption and NTBUDGET. The odds ratio for UTYPE is 4.5740, which indicates that, net of university size, N/T budget, MT1, and MT2, the odds of adopting ATM for Research Universities are 357% greater than for non-research universities. The odds ratio for NTBUDGET is 1.0540, which indicates that, net of university size, type, MT1, and MT2, the odds for universities with a higher N/T budget are 5.4% greater than for universities with a lower N/T budget. The p-value for MT1 is p < .05, which indicates that, irrespective of variable university size, university type, N/T budget, and the second index variable, there is a statistically significant relationship between ATM Adoption and the first index variable, namely the germane application of information system in university settings. This indicates that information processing maturity is statistically related to ATM adoption, which means that universities with germane application of information system are 101% more likely to adopt ATM than universities with immaterial applications of information system. The p-value for MT2 is p > .05. Therefore, it can be concluded that there is no statistically significant relationship between ATM Adoption and the second index variable, namely the immaterial application of information system in university settings. This conclusion supports the logic assumption that most universities have germane application of information system.

Model 4 submits a Model (^{2} of 53.953 relative to two degrees of freedom, which is statistically significant beyond p = .05. Compared to Model 3, Model 4 improves the goodness-of-fit (59.618 - 53.953 = 5.665) (5 - 3 = 2). As a result, Model 4 is better than Model 3 because variable MT1 further improves the fit by ((^{2} = 5.665 relative to two degrees of freedom.

Enrollment Size Model

A model separate from the nested models was performed for each independent variables in the nested models, namely, variables university type, finances, and information processing maturity (MT1 and MT2) using logistic regression. The results were very much similar to the results shown in the nested models, and they are not listed in tables for that particular reason. It was interesting to notice, however, that university size showed much less significant relationship to ATM adoption when compared with other variables. This is because variable ENROLLMT was used as a continuous variable. In reality, university size varies greatly from about 1,000 up to 50,000. Built on this fact, an additional model, Enrollment Size Model, was performed to analyze variable ENROLLMT based on the variable's enrollment classification of size: Small, Medium, Large, Very Large. The detailed analysis of variable ENROLLMT of Model 1 in [Tab. 5] revealed farther information about the relationship of university size and ATM adoption, and the results of this detailed analysis were far more informative and significant than Model 1 of [Tab. 4] in explaining the relationship of university size and ATM adoption. [Tab. 5] shows the logistic regression coefficients and Goodness-of-fit for the Enrollment Size Model.

Variable	Size Model	
	β	Exp (β)
ENROLLMT		

Size1	.0008***	2.0940
Size2	1.7716***	5.8800
Size3	2.7932***	16.3333
Model χ^2	24.288	
Df	3	
Significance	.0000	

*p< .05, **p< .01, ***p< .001

Table 5: Logistic Regression Coefficients and Goodness-of-Fit for Enrollment Size Model

As discussed above, variable ENROLLMT is significant in the nested models as shown in [Tab. 4], but its odds ratio is low, almost equal to 1 (Exp (β) = 1.0001). This is because ENROLLMT was used as one variable, disregarding the different size of each university. In the current model, however, enrollment size classification was involved and the odds ratio increased dramatically for Medium, Large, and Very Large categories, with reference to the Small size category. [Tab. 5] indicates that Medium size universities (Exp (β) = 2.0940) are 109% more likely to adopt ATM than Small size universities. Large size universities (Exp (β) = 5.8800) are 488% more likely to adopt ATM than Small size universities. Very Large size universities (Exp (β) = 16.3333) are 1533% more likely to adopt ATM than Small size universities. It is evident that university size does seem to be significantly related to ATM adoption. When classified, university size is a very good predictor of ATM adoption in campus networking.

Conclusion

Logistic regression statistical analysis shows that the variables university size, university type, university finances are all predictors of ATM adoption in campus networking. The MT1 index variable of information processing maturity is also a predictor of ATM adoption. Of these variables, university type is strongly associated with ATM adoption in campus networking. The statistics suggests that Research Universities are 357% more likely to adopt ATM than non-research universities, as shown in Model 4 of [Tab. 4]. University finances, namely Networking/Telecommunications budget, is also a good predictor of ATM adoption. The statistics indicate that universities with a higher N/T budget are 5.4% more likely to adopt ATM than universities with a lower N/T budget, as shown in Model 4 of [Tab. 4].

Statistics for MT1 shows that germane application of information systems is a significant predictor of ATM adoption, which indicates that universities with germane application of information systems tends to have higher information processing maturity. What this means is that universities with germane application of information systems, namely, germane application of information systems to support data and information handling, unstructured decision-making, and learning and research, are 101% greater to adopt ATM than universities without germane application of information systems. Thus, it is cognitive to conclude that information processing maturity is significantly related to ATM adoption.

In sum, the results of the statistical analysis support all the research questions of the study. Thus a conclusion is drawn: there is a statistically significant relationship between university size and ATM adoption; that there is a statistically significant relationship between university type and ATM adoption; that there is a statistically significant relationship between university finances and ATM adoption; that there is a statistically significant relationship between university information processing maturity and ATM adoption.

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